Physics 129 A
Fall 2004
Professor Freedman
October 13, 2004
Problem Set# 6 (Due: October 19, 2004)

(*These Problems are taken from Perkins Chapter 3*)

1. Show the reaction $\pi^- + d \rightarrow n + n + \pi^0$ cannot occur for pions at rest.

2. What restriction does the decay mode $K^0 \rightarrow 2\pi^0$ place on (a) the kaon spin (b) the kaon parity?

3. In which isospin states can (a) $\pi^+\pi^-\pi^0$, (b) $\pi^0\pi^0\pi^0$ exist?
   (Hint: First write the isospin wave functions for a pair of pions, and then combine each with the third pion.)

4. State which of the following decays of the ρ meson ($J^\pi = 1^-$, $I = 1$) are allowed by the strong or electromagnetic interaction:

   $\rho^0 \rightarrow \pi^+\pi^-$
   $\rightarrow \pi^0\pi^0$
   $\rightarrow \eta^0\pi^0$
   $\rightarrow \pi^0\gamma$

   where the η meson is an isosinglet.

5. The intrinsic parity of the hyperon Ξ^- with $S = -2$ can in principle be determined from the observations on capture in hydrogen from an *S*-state:

   $\Xi^- + p \rightarrow \Lambda + \Lambda$

   The polarization of the Λ hyperons produced can be found from the angular asymmetry of the products in the weak decay $\Lambda \rightarrow p + \pi^-$. State what is the polarization (if any) of the Λ particles produced in the above reaction and how the relative polarizations are determined from the parity of the Ξ^-.

6. Both the neutral mesons $\rho^0(770)$, with $J = 1$, and $f^0(1275)$, with $J = 2$, decay to $\pi^+\pi^-$. What are their *C* and *P* parities? State which of the decays $\rho^0 \rightarrow \pi^0 + \gamma$ and $f^0 \rightarrow \pi^0 + \gamma$ is or are allowed, and estimate the branching ratio.